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TECHNICAL

DESCRIPTION

MSX-E1731

Ethernet multifunction counter system

DIN EN ISO 9001:2008 certified

Edition: 02.01-04/2013

Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current status before printing.
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Warning

The following risks result from improper implementation and from use of the Ethernet system contrary to the regulations:

Personal injury

Damage to the Ethernet system, the PC and peripherals

Pollution of the environment

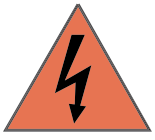
- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  If this leaflet is not enclosed with the documentation, please contact us and ask for it.
- Observe the instructions of this manual!

  Make sure that you do not forget or skip any step. We are not liable for damages resulting from a wrong use of the Ethernet system.
- Pay attention to the following symbols:

IMPORTANT!
Designates hints and other useful information.

WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the Ethernet system, the PC and/or peripherals may be **destroyed**.



WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the Ethernet system, the PC and/or peripherals may be **destroyed** and persons may be **endangered**.

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Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Important information on the application, the user and on handling the MSX-E system as well as safety precautions
2	Brief description of the MSX-E system (functions, features, block diagram)
3	Function description (EnDat counter inputs) including pin assignment and data format
4	Function description (digital inputs/outputs) including pin assignment and connection examples
5	Description of the function-specific tabs of the MSX-E web interface
6	List of technical data and limit values of the MSX-E system
7	Appendix with glossary and index
8	Contact and support address

1 Definition of application, user, handling

1.1 Definition of application

1.1.1 Intended use

The Ethernet system **MSX-E1731** for the acquisition, processing and transferring of EnDat sensor signals as well as for digital input or output is intended for the connection to a network, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm EN 61010-1 (IEC 61010-1).

1.1.2 Usage restrictions

The Ethernet system **MSX-E1731** must not be used as safety-related part (SRP).

The Ethernet system **MSX-E1731** must not be used for safety-related functions.

The Ethernet system **MSX-E1731** must not be used in potentially explosive atmospheres.

The Ethernet system **MSX-E1731** must not be used as electrical equipment according to the Low Voltage Directive 2006/95/EC.

1.1.3 Limits of use

All safety information and the instructions in the manuals must be followed to ensure proper intended use.

Uses of the Ethernet system beyond these specifications are considered as improper use.
The manufacturer is not liable for damages resulting from improper use.

The Ethernet system must remain in its anti-static packaging until it is installed.

Please do not delete the identification numbers of the Ethernet system or the warranty claim will be invalid.

1.2 Safety precautions

1.2.1 Current sources

All connected devices must be supplied from current sources that comply with SELV according to IEC 60950 or EN 60950; or PELV according to IEC 60204-1 or EN 60204-1.

1.2.2 Degrees of protection

IMPORTANT!
The protection according to the defined degree of protection (see Chapter 6.4) is only given if the openings are protected with adequate protection caps or connectors.

If you are not sure, please contact us:

Phone: +49 7229 1847-0

E-mail: info@addi-data.com

1.2.3 Cables

The cables must be installed safely against mechanical load.

1.2.4 Housing

The housing must not be opened. It may only be opened by persons who have been authorised by ADDI-DATA.

1.3 User

1.3.1 Qualification

Only persons trained in electronics are entitled to perform the following works:

- Installation
- Commissioning
- Use
- Maintenance.

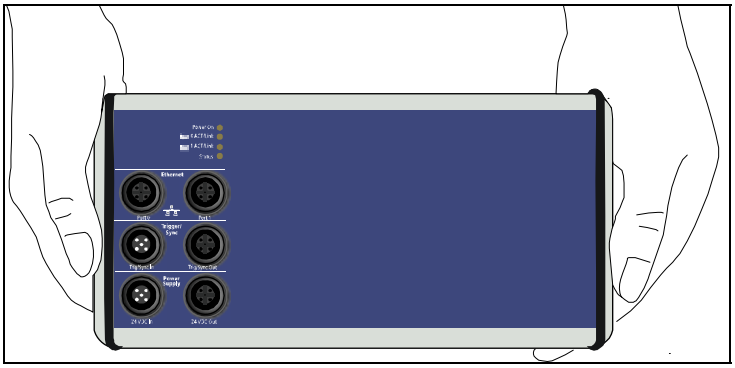
1.3.2 Country-specific regulations

Do observe the country-specific regulations regarding

- the prevention of accidents
- electrical and mechanical installations
- Electromagnetic compatibility (EMC).

1.4 Handling of the Ethernet system

Fig. 1-1: Correct handling



- Hold the Ethernet system by the bottom and the grey sides.
- Do not hold the Ethernet system by the connectors!

1.5 Questions and updates

You can send us any questions by e-mail or call us:

E-mail: info@addi-data.com

Phone: +49 7229 1847-0.

Manual and software download from the Internet

The latest versions of the technical manual and the standard software for the Ethernet system **MSX-E1731** can be downloaded for free at:

www.addi-data.com

IMPORTANT!

Before using the Ethernet system or in case of malfunction during operation, check if there is an update (manual, driver, firmware) available on our website or contact us directly.

2 Brief description

In this chapter, the functions and features of the Ethernet system **MSX-E1731** are described in brief. Furthermore, you will find a general block diagram of the MSX-E system.

2.1 Functions and features

The intelligent Ethernet system **MSX-E1731** has four counter inputs for EnDat 2.1 or EnDat 2.2 sensors as well as 16 digital inputs and outputs, which can be configured as pairs of inputs or outputs.

By means of an external trigger, the inputs and outputs on multiple systems can be updated simultaneously (synchronisation). The system can be configured and the acquisition can be started over either the integrated web interface or SOAP or Modbus commands. The signal generator data can be accessed via SOAP, Modbus or using the data server and the latch logic, over a socket.

Over an integrated Ethernet switch, the system can be cascaded with other MSX-E systems. This also applies to the voltage supply and the trigger/synchro line, which facilitates wiring between the single systems.

The Ethernet system is mounted in a robust EMC-protected metal housing, which complies with the degree of protection IP 65. In this way, the Ethernet system is able to cope with daily stresses and strains such as current peaks, vibrations, dirt or extreme temperatures. Moreover, it can be used in the extended operating temperature range from -40 °C to +85 °C and is equipped with numerous protective circuits. Error diagnoses are quickly identified by means of the “Status” LED display.

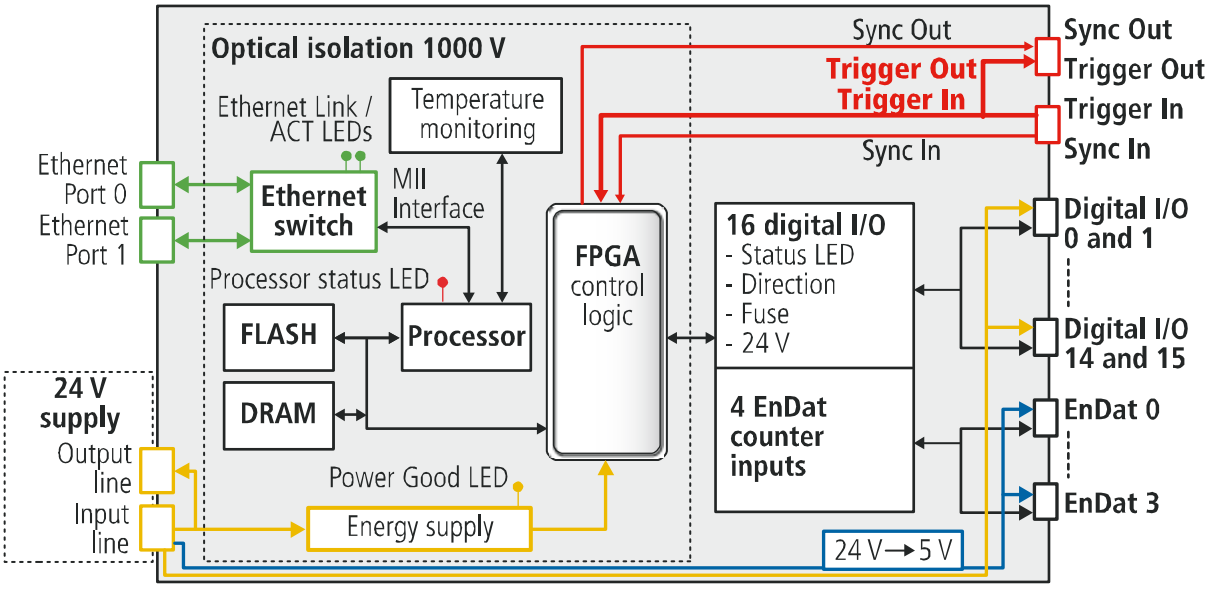
The electronics are no longer in the computer itself but in an external housing connected to the computer via Ethernet. As the Ethernet system is attached in direct vicinity of the signal generator or actuator, the function of the latter is no longer affected by long cables. The length of the (Ethernet) connection cable from the Ethernet system to the computer may be up to 150 m. The system must be supplied with external voltage (24 V).

Features:

- 4 EnDat counter inputs for the connection of EnDat sensors, 4 signal lines per channel (2 for clock, 2 for sending/receiving data), serial data transfer
- 16 digital inputs/outputs, 24 V, can be configured in pairs, LEDs to display level and direction
- Watchdog for resetting the outputs to “0” (these are set to “0” at Power-On)
- Input/output: can be controlled by means of an external trigger (digital 24 V trigger input)
- Web interface to configure, control and monitor the digital inputs/outputs and the EnDat counter inputs
- Data access via SOAP or Modbus (always TCP or UDP) or a socket
- Optical isolation
- Degree of protection: IP 65
- Cascadable; synchronisation in the µs range
- Extended operating temperature range from -40 °C to +85 °C

2.2 Block diagram

Fig. 2-1: MSX-E1731: Block diagram



3 Function description: EnDat counter inputs

The Ethernet system **MSX-E1731** is equipped with four EnDat counter inputs.

3.1 Pin assignment

To each M12 female connector, one EnDat sensor can be connected.

Table 3-1: Pin assignment: EnDat counter inputs

Pin No.	Female connector, 8-pin, M12	Polarity	Function	Signal name
2, 8	Voltage supply 5 V	Output 5 V	Supply for EnDat sensor	V+
5, 1	GND	GND	GND	
3	A+	Input/Output RS422	Data line	DATA_0+_x
4	A-			DATA_0-_x
7	B+	Output RS422	Clock line	CLK_0+_x
6	B-			CLK_0-_x
				

WARNING!
Please note that the EnDat 2.2 sensors are supplied by the **MSX-E1731** with a 5 V voltage. To see if a different voltage or voltage range is required, please refer to the datasheet for your sensor.

3.2 EnDat 2.2 interface

In the following chapters, the most important characteristics of the "EnDat 2.2" interface are described. More detailed information on this interface is to be found on the website www.endat.de as well as in the EnDat 2.2 specification, which can be ordered directly from the Heidenhain Company.

EnDat 2.2 is a bidirectional synchronous serial interface for position sensors.
This interface can be used to directly read out absolute position values without reference travel, to read out parameters, to write in status and initialisation registers and to transfer additional data on the position value. The **MSX-E1731** also supports diagnostic value analysis such as temperature and line break as well as access to the OEM memory area. Moreover, it enables performance resource analysis.

The connection cable consists of four differential lines for clock frequency, data transfer, voltage supply (5 V) and GND connection. Data transfer is purely serial.

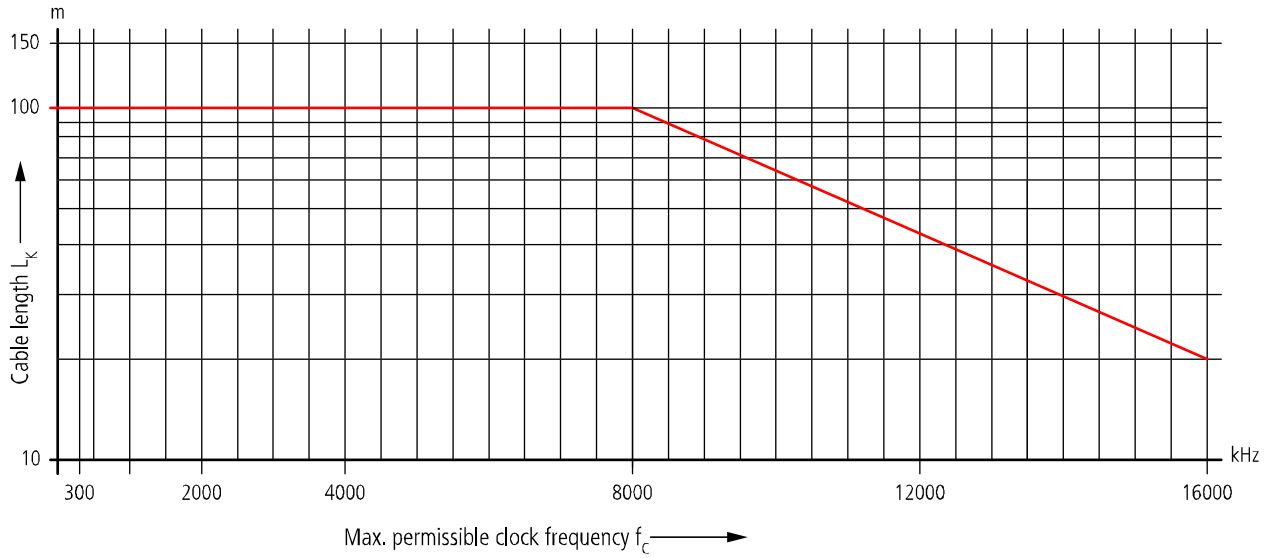
3.3 Frequencies and cable length

1) Clock frequency

The maximum clock frequency varies depending on the protocol version. With EnDat 2.1 sensors, it is mostly 2 MHz, with EnDat 2.2 sensors 8 MHz.

In consideration of the signal propagation delay compensation, which is supported by the **MSX-E1731**, a cable length of up to 100 m is possible at a clock frequency ≤ 8 MHz.

Fig. 3-1: Clock frequency with propagation-delay compensation



2) Transmission frequency

The maximum transmission frequency of the **MSX-E1731** is 4.5 MHz. The following transmission frequencies are available: 4500 kHz, 2500 kHz, 1500 kHz, 900 kHz and 500 kHz.

3.4 Position value request

For a detailed description of the individual software functions, read the SOAP documentation of the **MSX-E1731** (see MSX-E CD or driver download on the ADDI-DATA website).

3.4.1 Asynchronous mode

In asynchronous mode, the position values can be acquired in a faster and simpler way than in synchronous mode. However, the acquisition can be carried out neither periodically nor synchronously and the sampling frequency is low.

First, the EnDat sensor has to be initialised via the web interface (see Chapter 5.1.1) or an SOAP function (“MSXE173x__MFEndatInitSensor”) or a Modbus function.
Afterwards, each position value of the sensor can be queried with a Modbus function or the SOAP function “MSXE173x__MFEndatGetPosition”.
If the latter returns an error message, the function “MSXE173x__MFEndatGetErrorSources” is used for the detection of the error source. When the error has been cleared, the acquisition is continued with the function “MSXE173x__MFEndatResetErrorBits”.

Besides the position value, additional data can be transferred. After the initialisation of the sensor, this data has to be selected on the web interface or with the function “MSXE173x__MFEndatSelectAdditionalData”. This option applies only for EnDat 2.2 sensors.
A description of the additional data is available on the web interface or via the function “MSXE173x__MFEndatGetSensorProperties”.
In the event that the selected additional data is not supported by the sensor, an error message is displayed via the function “MSXE173x__MFEndatGetErrorSources”. This error message must be confirmed with the function “MSXE173x__MFEndatResetErrorBits”. To query the position value with additional data, the function “MSXE173x__MFEndatGetPositionWithAddData” has to be called up.

3.4.2 Synchronous mode

In this mode, the position values can be acquired periodically and with a high frequency. It is also possible to synchronise the acquisition with multiple MSX-E systems. Moreover, the position values of the sensor can be displayed in a standardised format instead of the raw value format (see Chapter 3.4.3).

The acquisition is started by a trigger and then runs automatically. As a trigger, either the hardware trigger (via the digital 24 V trigger input) or the system’s synchro trigger can be used. Each time the selected trigger occurs, the position value is acquired.
In combination with the synchro timer, a periodic acquisition is possible as well. For this, the synchro timer releases a synchro trigger in a defined interval (e.g. every 10 ms).

In synchronous mode, the position values can be acquired simultaneously with all connected EnDat sensors. The acquisition with multiple MSX-E systems can be synchronised using the synchro trigger.

With an acquisition in synchronous mode, the measurement data is sent from the MSX-E system to the clients via a socket connection. For this purpose, a socket connection with the data server of the MSX-E system needs to be opened first. The default port number of the data server is 8989. It is displayed on the web interface of the **MSX-E1731** under the menu item “Data server” where it can be changed, too.
Subsequently, the acquisition has to be started on the web interface (menu item “Acquisition”) or with an SOAP function (“MSXE173x__MFEndatInitAndEnableLatchPositionValues”) or Modbus function.

The main parameters of this function are:

- **Trigger source:** Event that starts the acquisition. Available types of trigger are hardware trigger and synchro trigger.
- **Module index:** Number of the EnDat sensor. To acquire the position values of all four sensors simultaneously, the function "MSXE173x__MFEndatInitAndEnableLatchPositionValues" has to be called up four times (once per sensor).
- **Data format:** Format of the packet that is sent by the data server to the connected clients

If the parameter "data format" is set to 0, the system sends a packet which contains the basic data:

Table 3-2: Basic data of the EnDat packet (data format)

Event source	Position (low)	Position (high)	Error
4 bytes	4 bytes	4 bytes	4 bytes
High 16-bit: Channels 0-3 Low 16-bit: Trigger source which has generated this packet Bit 0: Hardware trigger Bit 1: Synchro trigger Bit 2: Compare logic	Low bits of the position value of the sensor	High bits of the position value of the sensor	State of the communication with the sensor. The content of this packet must be considered only if 0.

Where a nonzero value is set for the parameter "data format", further values, i.e. supplementary data are attached to the data packet (see the following table). The parameter corresponds to a 5-bit value, with bits 0 to 3 corresponding each to a supplementary piece of information. Using bit 4, you can activate the direct conversion of the raw value into a standardised format (see Chapter 3.4.3).

Table 3-3: Supplementary data of the EnDat packet

Bit	Information	Size	Description	Values for parameter "data format"
0	Time stamp	4 bytes	Time stamp in s	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31
		4 bytes	Time stamp in µs	
1	Digital I/O state	4 bytes	Bit mask encoding all digital I/Os (1 bit corresponds to 1 digital I/O)	2, 3, 6, 7, 10, 11, 14, 15, 18, 19, 22, 23, 26, 27, 30, 31
2	Additional data 1	4 bytes	See web interface	4-7, 12-15, 20-23, 28-31
3	Additional data 2	4 bytes	See web interface	8-15, 24-31

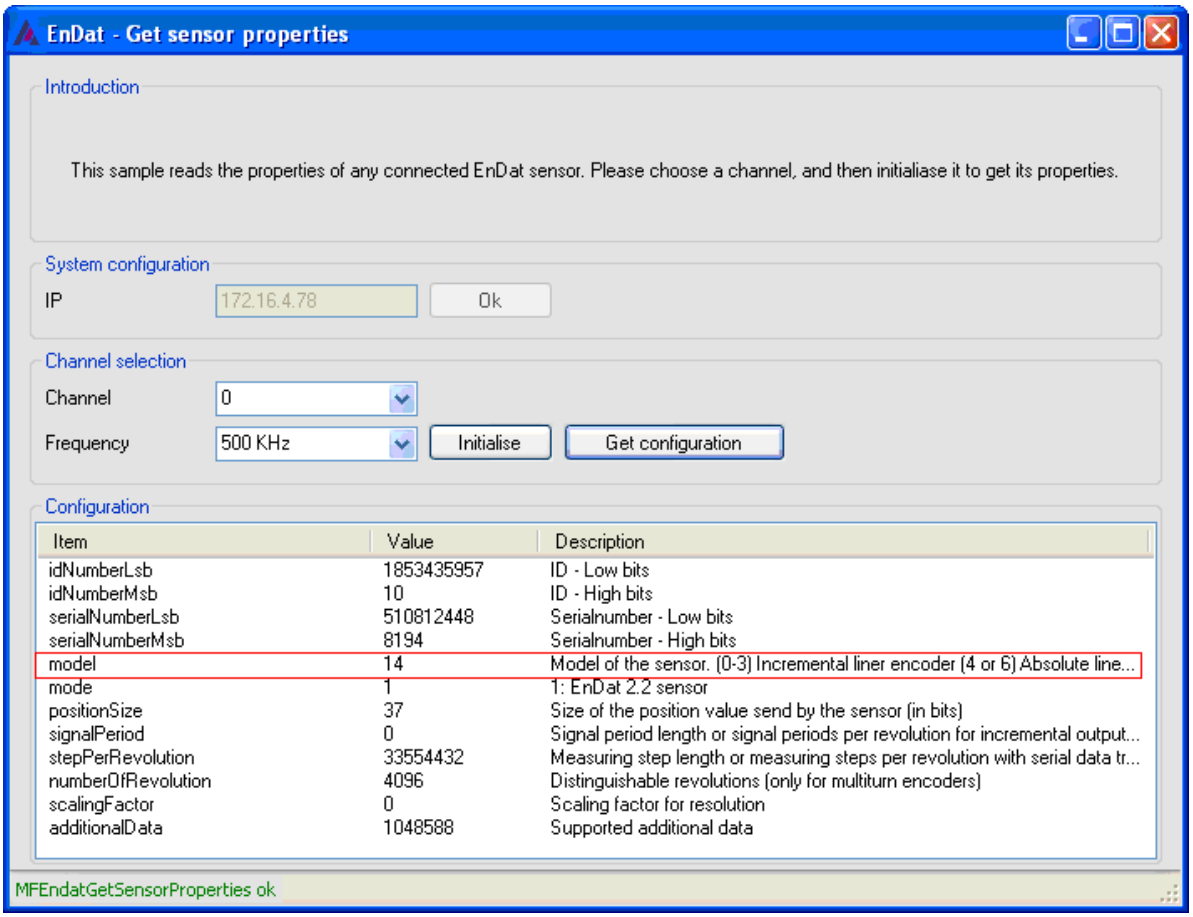
Once the acquisition has been started, the data server sends the packets to the connected clients.

IMPORTANT!
In case you do not receive any packets from the data server, you have to check if the trigger source has been correctly selected and if triggers are released.

3.4.3 Standardised format

The MSB of the parameter “data format” (software function for starting an acquisition in synchronous mode) allows transferring the position value as a standardised value.
If you set this bit to 1 (value for parameter “data format” between 16 and 31), the data format differs according to the sensor type. The sensor type is displayed with the SOAP function “MSXE173x__MFEndatGetSensorProperties” and in the sample “GetSensorProperties.exe” (see MSX-E CD or driver download on the ADDI-DATA website).

In the following example, a multi-turn sensor (model 14) is used.



To compute the value in the standardised format, the **MSX-E1731** currently supports two types of sensor:

- Absolute linear encoder (model 4 or 6)
- Multi-turn encoder (model 13 or 14)

If you use an absolute linear encoder and select the standardised format, the data server sends the following data packet:

Table 3-4: Absolute linear encoder (standardised data format)

Event source	Absolute position (m)	Error
4 bytes	4 bytes	4 bytes
High 16-bit: Channels 0-3 Low 16-bit: Trigger source which has generated this packet Bit 0: Hardware trigger Bit 1: Synchro trigger Bit 2: Compare logic	Encoded as a floating point value Value conversion into meters using the following formula: Absolute position (m) = transferred position value * measuring steps in nm * 1E-9	State of the communication with the sensor. The content of this packet must be considered only if 0.

The transferred position value in the column “Absolute position (m)” is the raw value measured by the sensor, i.e. the non-standardised value. “Measuring steps in nm” is a value that has been written by the sensor manufacturer into a register of the sensor. This value can be read out with the SOAP function “MSXE173x__MFEndatGetSensorProperties SOAP function”.

If you use a multi-turn encoder and select the standardised format, the data server sends the following data packet:

Table 3-5: Multi-turn encoder (standardised data format)

Event source	Position (low)	Position (high)	Absolute angle value (°)	Error
4 bytes	4 bytes	4 bytes	4 bytes	4 bytes
High 16-bit: Channels 0-3 Low 16-bit: Trigger source which has generated this packet Bit 0: Hardware trigger Bit 1: Synchro trigger Bit 2: Compare logic	Low bits of the position value of the sensor	High bits of the position value of the sensor	Encoded as a floating point value Value conversion into degrees using the following formula: Absolute angle value (°) = single-turn part * (360 / measuring steps per revolution)	State of the communication with the sensor. The content of this packet must be considered only if 0.

The single-turn part is computed from the raw value of the sensor. The SOAP function "MSXE173x__MFEndatGetSensorProperties" returns two parameters that are used to compute the single-turn part:

- **Position size** („ulPositionSize"): Total position size (multi-turn part size + single-turn part size)
- **Number of revolutions** („ulNumberOfRevolution"): Maximum number of revolutions that can be stored by the sensor, i.e. the maximum value of the multi-turn part. From this value, which is always a power of 2 (2^x), you can compute the size of the multi-turn part.

The size of the single-turn part is computed as follows:

single-turn part size = position size - multi-turn part size

Please find further information on this on the web interface of the **MSX-E1731** (menu item "Acquisition", "Help" tab).

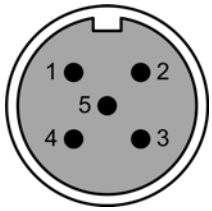
4 Function description: Digital inputs/outputs

The Ethernet system **MSX-E1731** has 16 digital inputs or outputs for sensors or actuators.

4.1 Pin assignment

To each M12 female connector, up to two sensors or actuators can be connected. In addition, a 24 V supply is available.

Table 4-1: Pin assignment: Digital inputs/outputs

Pin No.	Female connector, 5-pin, M12	Cable (black)
		Lead colour
1	24 V output	brown
2	Digital I/O (2n+1)*	white
3	GND	blue
4	Digital I/O (2n)*	black
5	not connected	grey
		

* Please note that the female connector (n) is dual-wired and that the digital I/Os are determined via (2n+1) or (2n) with 0 ≤ n ≤ 7.

Examples:

Female connector 0 (n=0) –> Pin 2: (2 x 0 + 1) –> Digital I/O 1
–> Pin 4: (2 x 0) –> Digital I/O 0

Female connector 7 (n=7) –> Pin 2: (2 x 7 + 1) –> Digital I/O 15
–> Pin 4: (2 x 7) –> Digital I/O 14

4.2 LED display

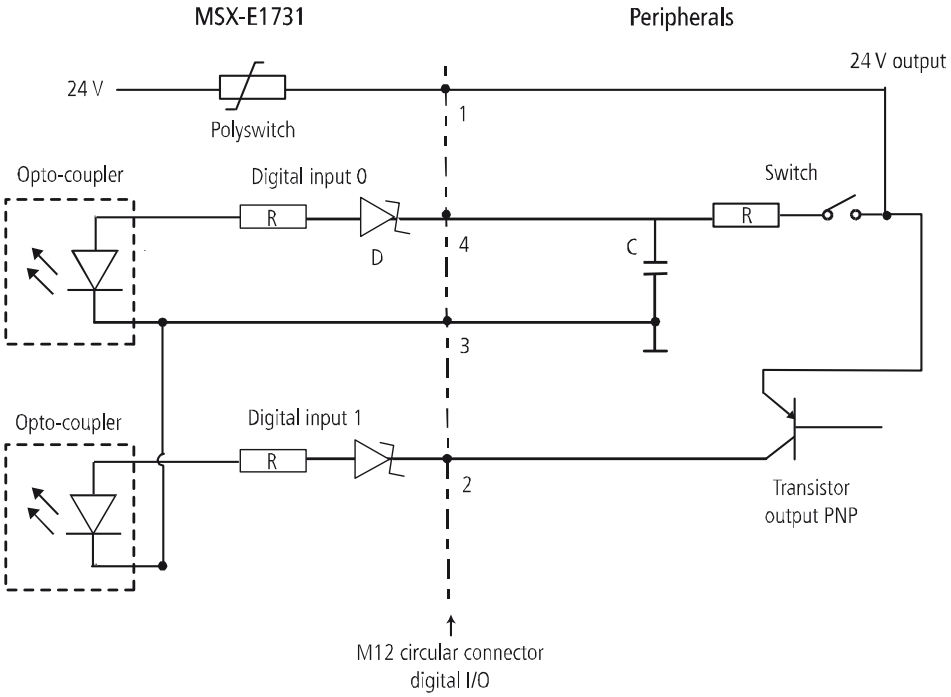
Table 4-2: LED display: Digital I/O

Direction	Status	LED	Meaning
Output	inactive	black 	- No output active - No voltage applied
Output	active	Lights red 	- Output is active - No voltage applied **Caution, risk of short-circuit!**
Input	inactive	Lights green 	- Input is ready for operation - Signals can be received
Input	active	Lights yellow 	- Input is active - Signal being received

4.3 Connection examples

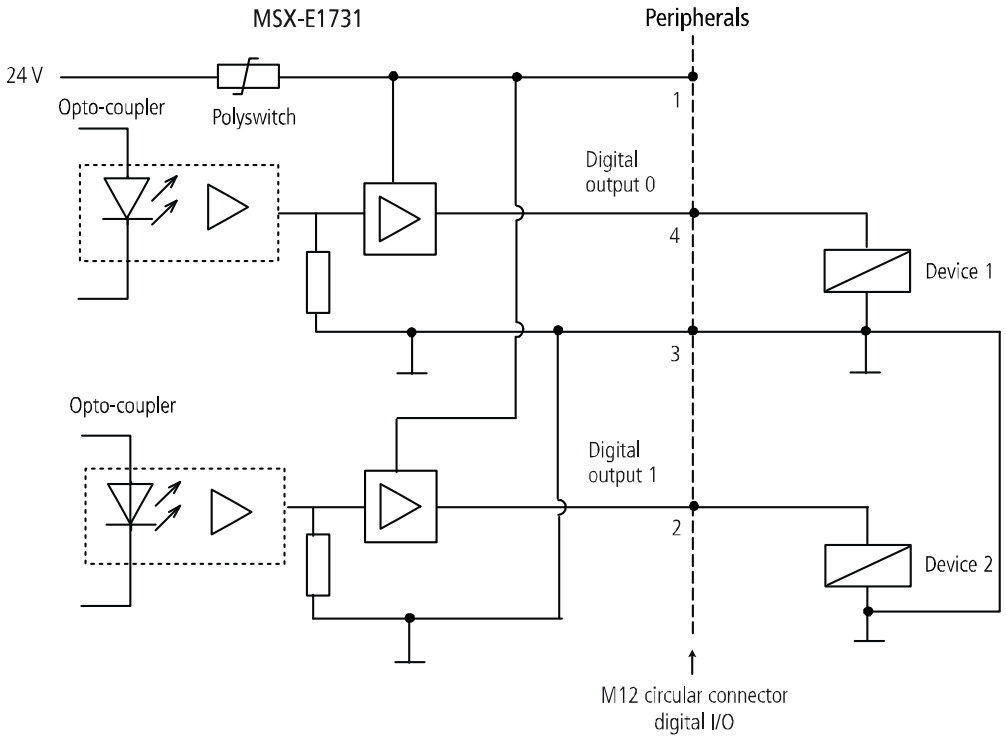
4.3.1 Digital inputs (24 V)

Fig. 4-1: Connection example: Digital inputs (24 V)



4.3.2 Digital outputs (24 V)

Fig. 4-2: Connection example: Digital outputs (24 V)



4.4 Digital outputs

By default, the digital channels of the **MSX-E1731** are configured as inputs.
In order to convert a port, i. e. a pair of channels into an output, the configuration has to be changed on the web interface of the MSX-E system (see Chapter 5.1.2) or via the SOAP or Modbus function "DigitalIOInitPortConfiguration".

IMPORTANT!
For each connector or port, only inputs or outputs can be configured. In the event of a system reboot, the configuration is only persistent if it has been changed on the web interface.

The ports configured as outputs are high-impedance. The status of the outputs can be read back by way of control.

If a short-circuit occurs at a connected output, this output will be deactivated.
As soon as the short-circuit has been eliminated, a rearm has to be carried out to reactivate the output (see Chapter 5.1.1). This means that the output is set to the status value that was programmed before the short-circuit occurred. A new value can only be defined after the rearm event.

4.5 Watchdog

The Ethernet system **MSX-E1731** has a 16-bit watchdog, which is programmable in three time units (µs, ms, s). The watchdog is used to reset the digital outputs to 0 V after a specific time.

Operation of the watchdog

1. After the system reboot, the watchdog is in “Uninitialised” state.
   It can be initialised and activated (“Running” state) over the web interface of the MSX-E system or by a software function.
2. With the first write access to the outputs, the watchdog is started: The watchdog time is loaded and the watchdog starts counting down.
   As long as the watchdog time has not elapsed, the watchdog is triggered with every further write access to the outputs, i.e. the watchdog time is reloaded.
3. When the watchdog time has elapsed, the watchdog is put in “Overrun” state and all digital outputs are set to 0 V or 0 mA. In “Overrun” state, any write access to the outputs is ignored.
4. To re-enable write access, the watchdog first has to be put in “Stopped” state (web interface) or deactivated by a software function.
   To reactivate the watchdog, it has to be put in “Running” state again or reinitialised and reactivated by a software function.

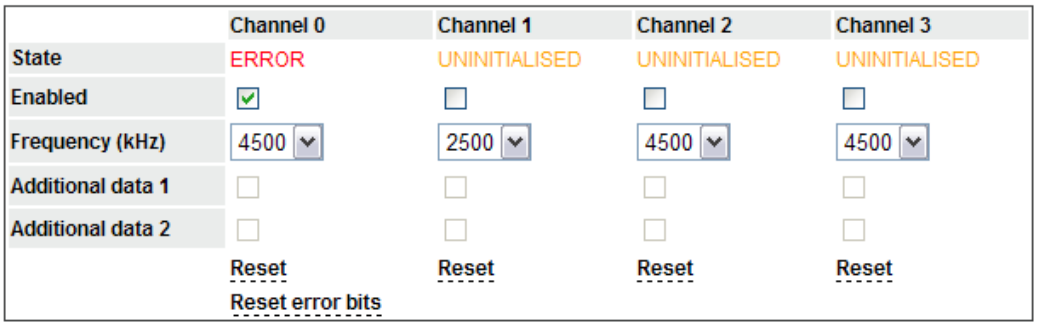
5 Web interface: Quick access to the MSX-E system

In this chapter, the system-specific parts of the **MSX-E1731** web interface are described. For further information on the MSX-E web interface, please refer to the general manual of the MSX-E systems (see PDF link).

5.1 Menu item "I/O Configuration"

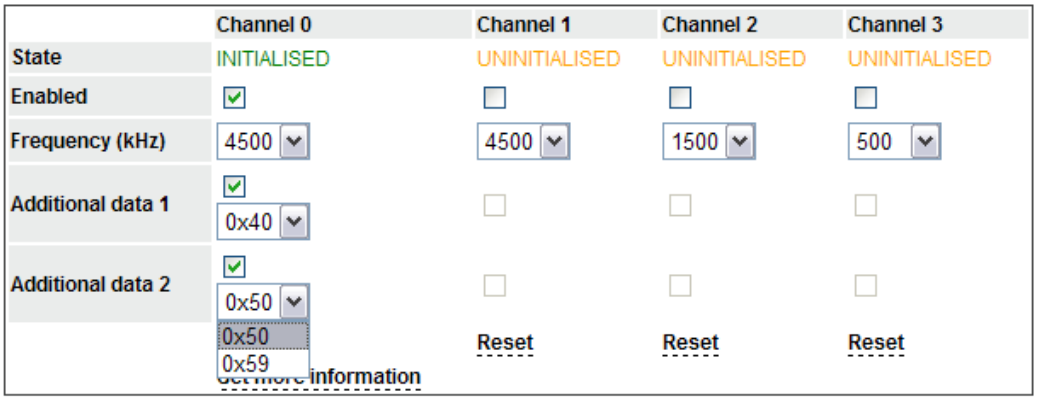
5.1.1 "EnDat" tab

Fig. 5-1: "EnDat" table



In the "EnDat" table, you can configure the EnDat channels and retrieve the state of the connected sensors. To initialise the sensors, you first need to select the corresponding channels (see table line "Enabled") and then click in the tool bar above on the "Set and save" button.

Fig. 5-2: Additional data selection



After the initialisation, the MSX-E system automatically detects the type of additional data supported by the respective sensor. The additional data is described below the "EnDat" table and can be selected for each corresponding channel in the table lines "Additional data 1" and "Additional data 2".

IMPORTANT!
The configuration only takes effect if you click on the “Set and save” button.

5.1.2 “Digital I/O” tab

Fig. 5-3: Digital inputs/outputs

Channel	State	Direction	Channel	State	Direction
0	Low	Input	8	Low	Input
1	Low		9	Low	
2	Low	Input	10	High	Output
3	Low		11	High	
4	High	Output	12	Low	Output
5	Low		13	Low	
6	Low	Input	14	Low	Output
7	Low		15	Low	

In this table, you can configure the digital channels as pairs of inputs or outputs. For each output, also the status (“High” or “Low”) can be defined by clicking on the corresponding button.

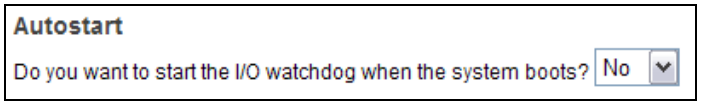
Fig. 5-4: Digital output: Rearm

Channel	State	Type	Channel	State	Type
0	-	Input	8	-	Input
1	-		9	-	
2	-	Input	10	-	Output
3	-		11	-	
4	-	Output	12	-	Output
5	-		13	-	
6	-	Input	14	-	Output
7	-		15	Short-circuit (Click to rearm)	

In case of a short-circuit at an output, the state of all outputs cannot be changed for the time being and also the state of the inputs is no longer displayed. When the short-circuit has been fixed, a rearm (see Chapter 4.4) needs to be carried out via the button “Click to rearm”. Afterwards, the table column “State” is available again.

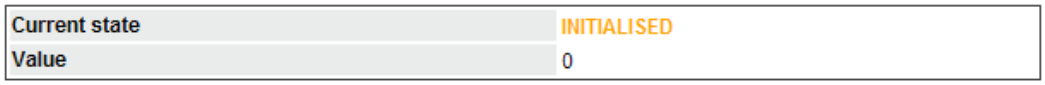
The watchdog can be configured, started and stopped on the “Digital I/O” tab.

Fig. 5-5: I/O Watchdog: Autostart



There is also the possibility to automatically start the watchdog with the saved configuration after the system has booted up.

Fig. 5-6: I/O Watchdog: Current state



The current watchdog state and time are displayed. The time value is refreshed every 500 ms.

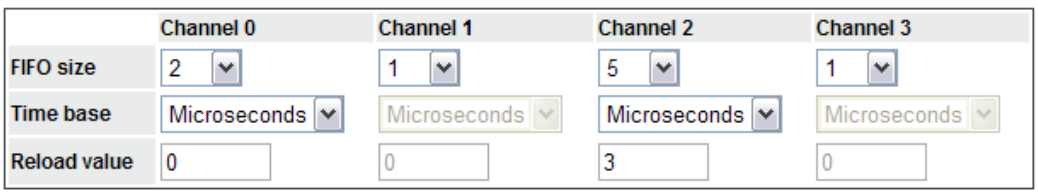
Fig. 5-7: I/O Watchdog: Configuration

You can configure the watchdog by defining the unit and the value of the watchdog time.

IMPORTANT!
The configuration only takes effect if you click on the “Set and save” button.

5.1.3 “FIFO size” tab

Fig. 5-8: FIFO size: Configuration



To prevent a cache overflow, in the table line “FIFO size”, you can define for each EnDat channel the number of data packets that should be stored in the FIFO buffer before they are sent to the client by the data server.
Also, the data can be sent after a timeout, even if the FIFO buffer is not full yet. For this, in the table line “Time base”, a time unit and with “Reload value”, a value between 0 and 65535 for the timeout time need to be selected. If this value is 0, the data will only be sent when the FIFO buffer is full.

5.2 Menu item “Acquisition”

5.2.1 “Latch” tab

Fig. 5-9: Acquisition: Channel configuration

	Channel 0	Channel 1	Channel 2	Channel 3
Designation	EnDat sensor 0	EnDat sensor 1	EnDat sensor 2	EnDat sensor 3
State (Reload)	INITIALISED	UNINITIALISED	INITIALISED	UNINITIALISED
Enabled	☑	☐	☑	☐
Hardware trigger	☐	☐	☐	☐
Synchro trigger	☑	☑	☑	☑
Receive time stamp	☑	☐	☑	☑
Receive digital I/O state	☑	☑	☑	☑
Receive additional data 1	☐	☐	☐	☐
Receive additional data 2	☐	☐	☐	☐
Standardised format	☐	☐	☑	☐

Before starting the acquisition, you have to configure the EnDat channels with the initialised sensors.

The acquisition is started and stopped in the tool bar above (“Start” and “Stop” buttons). In addition, the configuration can be saved in a file (“Save as”) and later be reloaded (“Load configuration”). Moreover, you can display the source code as a C sample (“Source code”).

On this tab, also the data format (see Chapter 3.4) is shown for each EnDat channel.

5.2.2 “Monitor” tab

When the acquisition has been started, the number of data packets to be transferred can be entered. Via the button “Display as table”, all values sent for each EnDat channel are displayed.

5.2.3 „Help“ tab

Here, you can find detailed information on the multi-turn encoder, the standardised format and the data transfer (see also Chapter 3.4).

6 Technical data and limit values

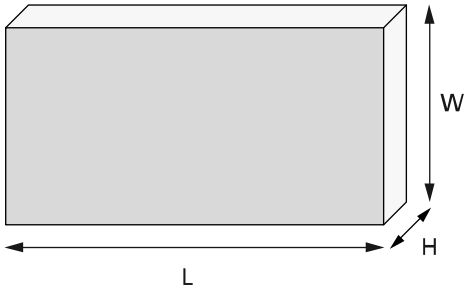
6.1 Electromagnetic compatibility (EMC)

The Ethernet system **MSX-E1731** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the norm from the EN 61326 series (IEC 61326).
The limit values as set out by the European EMC directive for an industrial environment are complied with.

The respective EMC test report is available on request.

6.2 Mechanical structure

Fig. 6-1: MSX-E1731: Dimensions



Dimensions (L x W x H):	215 x 110 x 54 mm
Weight:	900 g 960 g (with MX-Rail)

Fig. 6-2: MSX-E1731: View from above

6.3 Versions

The specific version name can be found on the type label of your Ethernet system (see also Chapter 1.1 of the general MSX-E manual).

6.4 Limit values

Height:	2000 m over NN
Operating temperature:	-40 °C to +85 °C
Storage temperature:	-40 °C to +85 °C
Relative air humidity at indoor installation:	50 % at +40 °C 80 % at +31 °C (Ice formation from condensation must be prevented.)
Current supply:	
Nominal voltage:	24 VDC
Supply voltage:	18-30 V
Current consumption (at 24 V):	150 mA ±10 %
Safety:	
Degree of protection:	IP 65[1]
Optical isolation:	1000 V
Reverse polarity protection:	1 A max.

IMPORTANT!
After boot-up, the MSX-E system should warm up for a minimum 15 minutes so that a constant internal temperature will be reached.

6.4.1 Ethernet

Number of ports:	2
Optical isolation:	1000 V
Cable length:	150 m (max. for CAT5E UTP)
Bandwidth:	10 Mbps (auto-negotiation) 100 Mbps (auto-negotiation)
Protocol:	10 Base-T according to IEEE 802.3 100 Base-TX according to IEEE 802.3
MAC address:	00:0F:6C:##:##:## (unique for each device)

[1] The degree of protection is only provided when the relevant protection caps are used.

6.4.2 Trigger input

24 V trigger input

Number of inputs:	1
Filter/Protective circuit:	low-pass/transorb diode
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Input voltage:	0-30 V
Input current:	11 mA typ. (at nominal voltage)
Max. input frequency:	2 MHz (at nominal voltage)
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

5 V trigger input (optional)

Number of inputs:	1
Filter/Protective circuit:	low-pass/transorb diode
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	5 VDC
Input voltage:	0-5 V
Input current:	12 mA typ. (at nominal voltage)
Max. input frequency:	1 MHz (at nominal voltage)
Signal threshold:	2.2 V typ.

6.4.3 Synchro input and output

Number of inputs:	1
Number of outputs:	1
Optical isolation:	1000 V
Output type:	RS422
Driver level (master) V_{A-B}:	≤ -1.5 V (low) ≥ 1.5 V (high)
Receiver level (slave) V_{A-B}:	≤ -200 mV (low) ≥ 200 mV (high)

6.4.4 EnDat counter inputs

Number of inputs:	4 (with A and B signals each)
Input type:	differential
Nominal voltage:	5 VDC
Sensor supply:	
Voltage:	5 V ±10 %
Current:	500 mA max. (per female connector)
Differential inputs:	comply with EIA standards RS422A
Common mode range:	+12 V to -7 V

Input sensitivity:	±200 mV
Input hysteresis:	50 mV typ.
Max. input frequency:	5 MHz
Input impedance:	12 kΩ min.
"Open Circuit Fail Safe Receiver Design":	"1" = inputs open
ESD protection:	up to ±15 kV

6.4.5 Digital inputs

Number of inputs:	16 (2 per female connector / common GND according to IEC 1131-2)
Overvoltage protection:	30 V
Optical isolation:	1000 V (via opto-couplers)
Nominal voltage:	24 VDC
Input voltage:	0-30 V
Max. input frequency:	1 MHz (at nominal voltage)
Input impedance:	> 1 MΩ
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

6.4.6 Digital outputs

Number of outputs:	16 (2 per female connector)
Optical isolation:	1000 V (via opto-couplers)
Output type:	high-side (load to ground according to IEC 1131-2)
Nominal voltage:	24 V
Supply voltage:	18-30 V
Current:	1.85 A max. (for each group[2]) via PTC
Output current per output:	500 mA max.
Short-circuit current per output:	1.7 A max. shutdown logic at 24 V, R_{Load} = 10 mΩ
R_{DS} ON resistance:	280 mΩ max.
Switch-on time:	100 µs (max. R_L = 48 Ω of 80 % V_{out})
Switch-off time:	150 µs (max. R_L = 48 Ω of 10 % V_{out})
Overtemperature (shutdown):	135 °C max. (output driver)
Temperature hysteresis:	15 °C typ. (output driver)
Diagnosis:	common diagnostic bit for all 16 channels at overtemperature of one channel

[2] Group 1: Digital outputs 0 to 3, 8 to 11 and the respective 24 V outputs
Group 2: Digital outputs 4 to 7, 12 to 15 and the respective 24 V outputs

6.4.7 Watchdog

Number:	1
Resolution:	16-bit
Time base:	µs, ms, s (programmable)
Time value range:	1 to 65535

7 Appendix

7.1 Glossary

Cascading
Cascading means connecting multiple similar elements together to enhance their individual effect. The individual elements must be such that the outputs of a given element are compatible with the inputs of the subsequent element in terms of values and functionality.

Counter
A counter is a circuit that counts pulses or measures pulse duration.

Data acquisition
Data acquisition means gathering information from sources such as sensors and transducers in an accurate, timely and organised manner. Modern systems convert this information to digital data which can be stored and processed by a computer.

Digital signal
A digital signal is a digital representation of a constantly changing value or other piece of information. Digital signals consist of a finite number of values. The smallest possible difference between two digital values is referred to as the resolution. Digital signals are discontinuous in terms of value and time ranges.

Driver
A driver is a series of software instructions written specifically to manage particular devices.

EMC
= Electromagnetic Compatibility

The definition of the VDE regulation 0870 states: Electromagnetic compatibility is the ability of an electrical installation to function satisfactorily within its electromagnetic environment without unduly affecting its environment and the equipment it contains.

ESD
= Electrostatic Discharge

On non-conductive surfaces, an electric charge is conducted away very slowly. If the dielectric strength is overcome, there is a fast potential equalisation between the surfaces involved. The often very sudden equalisation process is referred to as electrostatic discharge (ESD). Currents of up to 20 A may occur in this process.

Ethernet
The Ethernet is a baseband bus system originally developed in order to connect mini-computers. It is based on the CSMA/CD access method. Coaxial cables or twisted-pair cables are used as the transmission medium.
The transmission speeds are 10 Mbit/s (Ethernet), 100 Mbit/s (Fast Ethernet) and 1 Gbit/s or 10 Gbit/s (Gigabit-Ethernet). This widely used technology for computer networking in a LAN has been standardised since 1985 (IEEE 802.3 and ISO 8802-3). Ethernet technology is now common practice in the office environment. After making even very tough real-time requirements possible and adapting the device technology (bus cables, patch fields, junction boxes) to the harsh application conditions of the industrial environment, Ethernet is now also increasingly used in the field areas of automation technology.

Event
An event is an occurrence detected by the MSX-E system. Where e. g. a short-circuit is detected and an event is activated, a short-circuit warning can be sent via the event server.

Ground line
Ground lines should not be seen as potential-free return lines. Different ground points may have small potential differences. This is always true with large currents and may cause inaccuracy in high-resolution circuits.

Hysteresis
Hysteresis is the difference between the start-up and shut-down voltage. In TTL circuits, it is typically 0.8 V; in CMOS circuits, it depends on the supply voltage.

IEC
= International Electrotechnical Commission

The IEC is a UN body affiliated to the ISO (International Standards Organisation) which sets standards for electrotechnical parts and components.

Input impedance
The input impedance is the ratio of voltage to current at the input terminals when the output terminals are open.

Input level
The input level is the logarithmic ratio between two electrical values of the same type (voltage, current or power) at the signal input of any receiving unit. This unit is often configured as a logical level related to the input of the circuit. The input voltage corresponding to logic "0" is between 0 V and 15 V and the voltage corresponding to logic "1" is between 17 V and 30 V.

IP degree of protection
The IP standard defines the degree of protection of a system against dirt and water. The first figure after the "IP" (e.g. 6 in IP 65) indicates the degree of protection against solid objects penetrating the housing. The second figure indicates the degree of protection against liquids penetrating the housing.
In IP 65, the figures 6 and 5 have the following meaning: 6 = full protection against moving parts and against dirt penetration;
5 = protection against jets of water from any direction.
In IP 40, the figure 4 equates to protection against contact with small objects and protection against small foreign bodies (larger than 1 mm). The figure 0 means that there is no protection.

Level
Logic levels are defined for processing and displaying information.
In binary switches, voltages are used for digital values. Here, the two voltage ranges "H" (high) und "L" (low) represent the information.
The "H" range is closer to plus infinity; the "H" level corresponds to digital 1. "L" denotes the range closer to minus infinity; the "L" level corresponds to digital 0.

Limit value
Exceeding the limit values, even for a short time, can easily result in the destruction of the component or the (temporary) loss of functionality.

MAC address
MAC = Media Access Control

This is the hardware address of network components used to identify them uniquely within the network.

Optical isolation
Optical isolation means that there is no flow of electrical current between the circuit to be measured and the measuring system.

Protective circuit
A protective circuit is set up on the actuator side to protect the control electronics and provide adequate EMC safety. The simplest protective circuit involves connecting a resistor in parallel.

Resolution
The resolution indicates how precisely a signal or value is held within the computer.

Short-circuit
A short-circuit exists between two terminals of an electric circuit if the relevant terminal voltage is zero.

SOAP
= Simple Object Process Protocol

SOAP is a simple extensible protocol for exchanging information in distributed environments. It defines XML messages that can be exchanged between heterogeneous applications via HTTP.

SOAP is independent of operating systems and can be integrated into existing Internet structures, including Ethernet TCP/IP-based automation concepts. SOAP is based on Remote Procedure Calls and XML. This means that functions from other platforms can be called and used from any point within the network. Any results data can also be returned using XML schemas. This enables distributed computing capacity and non-redundant data storage in distributed systems.

Switch-off time
The switch-off time is the time between the control current being switched off and the output voltage falling to 10% of its original value.

TCP/IP
= Transmission Control Protocol/Internet Protocol

TCP/IP is a family of network protocols and therefore often just referred to as Internet protocol. The computers that are part of the network are identified via their IP addresses. UDP is another transport protocol that belongs to the core group of this protocol family.

Timer
A timer is used for adjusting time-dependent program processes between the processor and peripheral devices. It contains counters that are mostly independent of each other and can be programmed like a programmable I/O module via a control word register for different operating types.

Trigger
A trigger is a pulse or signal for starting or stopping a special task. Triggers are often used for controlling data acquisition.

UDP
= User Datagram Protocol

This is a minimal connection-free network protocol which is part of the transport layer within the Internet protocol family. The purpose of UDPs is to ensure that data transmitted over the Internet reach the correct application.

Watchdog
A watchdog is an electronic delay switch used to monitor key components or devices. It is activated periodically and triggers an alarm after a specified time. If the unit to be monitored is working correctly, the watchdog is reset before triggering the alarm.

7.2 Index

8 Contact and support

Do you have any questions? Write or phone us:

Address: ADDI-DATA GmbH
Airpark Business Center
Airport Boulevard B210
77836 Rheinmünster
Germany

Phone: +49 7229 1847-0
Fax: +49 7229 1847-222

E-mail: info@addi-data.com

Manual and software download from the Internet:

www.addi-data.com